Geophysical Data Report

ATMOSPHERIC RADIO NOISE DATA BANGKOK, THAILAND — December 1967-February 1968

By: RANGSIT CHINDAHPORN PONSAK BUASRI

Prepared for:

U.S. ARMY ELECTRONICS COMMAND
FORT MONMOUTH, NEW JERSEY 07703

CONTRACT DA-36-039 AMC-00040(E)
ORDER NO. 5384-PM-63-91

Sponsored By
ADVANCED RESEARCH PROJECTS AGENCY
ARPA ORDER 371
FOR THE
THAI-U.S. MILITARY RESEARCH AND DEVELOPMENT CENTER
SUPREME COMMAND HEADQUARTERS
BANGKOK, THAILAND

STANFORD RESEARCH INSTITUTE

MENLO PARK, CALIFORNIA

STANFORD RESEARCH INSTITUTE
MENLO PARK, CALIFORNIA

May 1968

Geophysical Data Report

ATMOSPHERIC RADIO NOISE DATA BANGKOK, THAILAND — December 1967-February 1968

Prepared for:

U.S. ARMY ELECTRONICS COMMAND
FORT MONMOUTH, NEW JERSEY 07703

CONTRACT DA-36-039 AMC-00040(E)
ORDER NO. 5384-PM-63-91

By: RANGSIT CHINDAHPORN PONSAK BUASRI

SRI Project 4240

Sponsored By
ADVANCED RESEARCH PROJECTS AGENCY
ARPA ORDER 371
FOR THE
THAI-U.S. MILITARY RESEARCH AND DEVELOPMENT CENTER
SUPREME COMMAND HEADQUARTERS
BANGKOK, THAILAND

CONTENTS

LIST OF ILLUSTRATIONS iii
LIST OF TABLES. iii

I INTRODUCTION 1
II DISCUSSION 7

APPENDIX - RADIO NOISE VALUES 9

ILLUSTRATIONS

Fig. 1	ARN-3 Atmoapheric Radio Noise Measuring Equipment	2
Fig. 2	Location of the Radio Noise Recording Station st Laem Chabang, Thailand	3
Fig. 3	Radio Noise Recording Station	4
Fig. 4	Nomogram for Transforming Effective Antenna Noiae Figure to Noiae Field Strength as a Function of Frequency	6
Fig. A-1	Three-Month Median Time-Block Values of Radio Noise Power	14

TABLES

Table I	Radio Noise Measuring Site at Laem Chabang, Thailand	5
Table II	ARN-3 Radio Noise Recorder Specifications.	5
Table A-1	Month-Hour Values of Radio Noise	10
Table A-2	Three-Month Time-Block Values of Radio Noise	13

I INTRODUCTION

Measurements of atmospheric radio noise are being made by the Electronics Laboratory of the Military Research and Development Center (MRDC-EL), a joint Thailand-United States-organization in Bangkok. The noise-measuring equipment (Fig. 1), modeled after the U.S. National Bureau of Standards Radio Noise Recorder, Model ARN-2, is located near the village of Laem Chabang (Fig. 2), about 90 kilometers southeast of Bangkok, in order to minimize interference from man-made noise. A view of the site, showing the standard ARN-2 antenna and ground plane, is presented in Fig. 3.

The cooperation and participation of the staff members of the Thailand Ministry of Defense and the support of the United States Advanced Research Projects Agency and the U.S. Army Electronics Command, have made it possible for the data presented in this report to be accumulated.

Tables I and II, below, present information about the site and the equipment.

For convenience in applying the results in this study, a nomogram for transforming effective antenna noise figure to noise field strength as a function of frequency is presented in Fig. 4.

This is the last of a series of quarterly data reports on atmospheri radio noise data obtained with the ARN-3 equipment at Laem Chabang, Thailand.

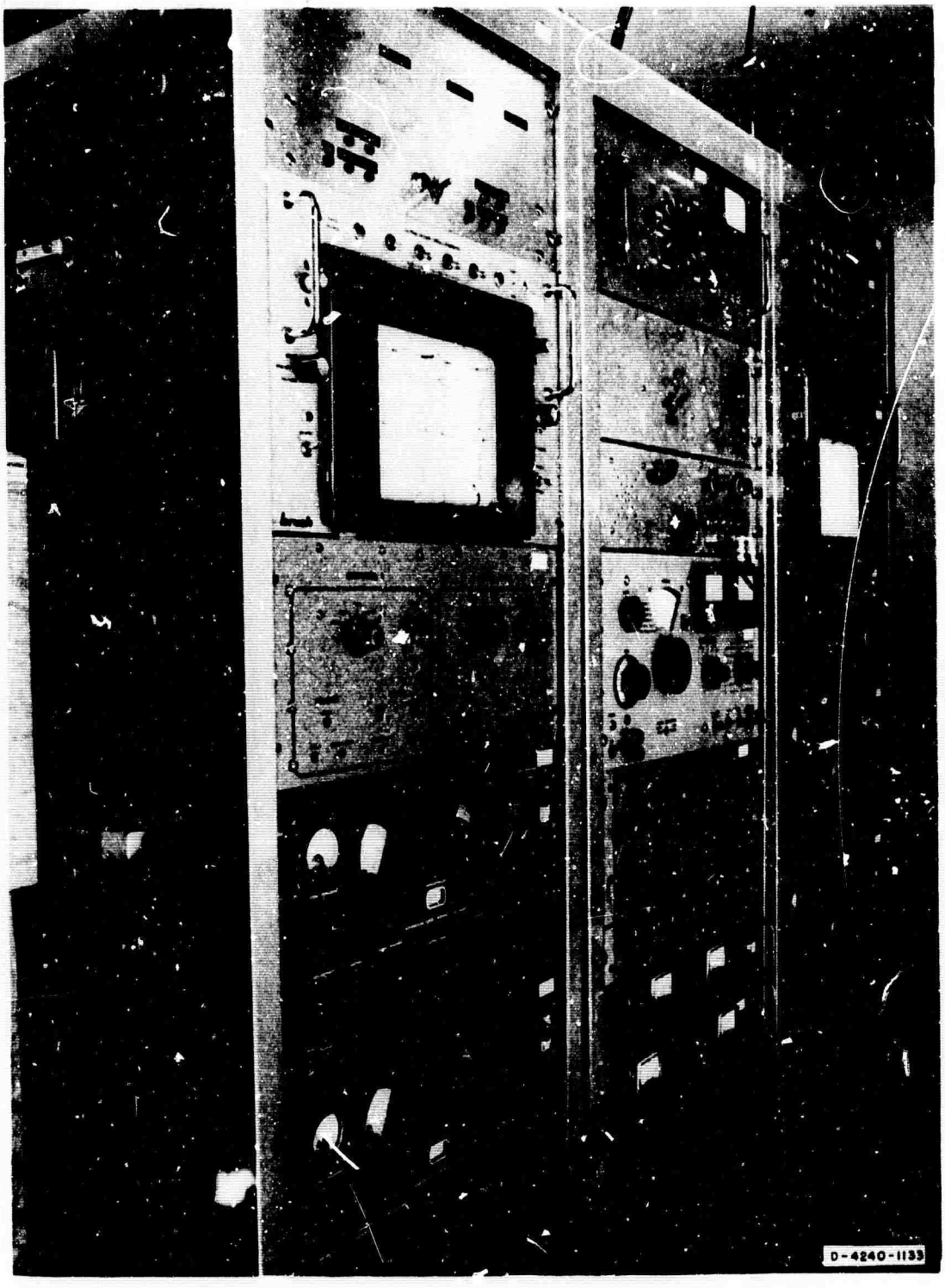


FIG. 1 ARN-3 ATMOSPHERIC RADIO NOISE MEASURING EQUIPMENT

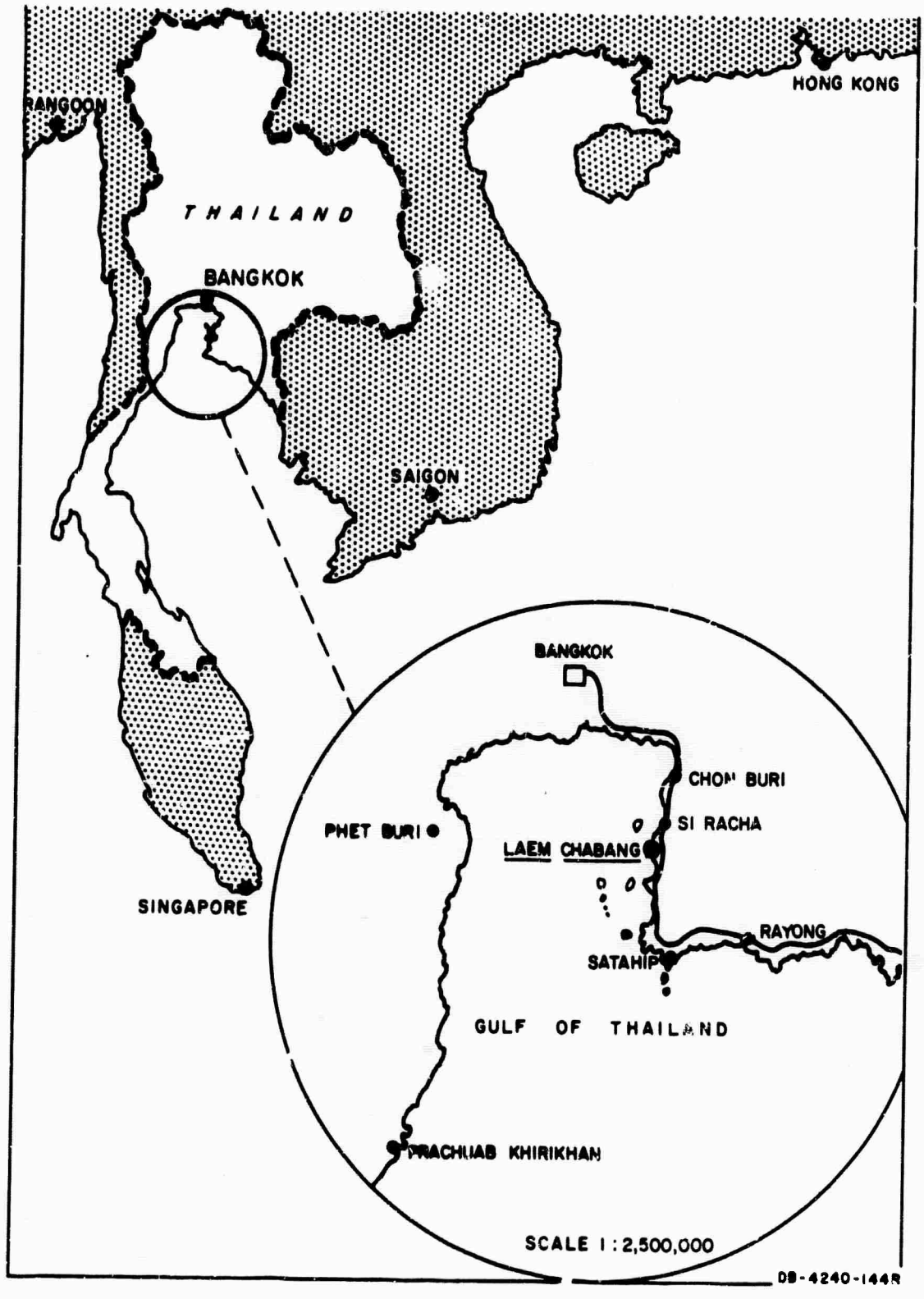


FIG. 2 LOCATION OF THE RADIO NOISE RECORDING STATION AT LAEM CHABANG, THAILAND

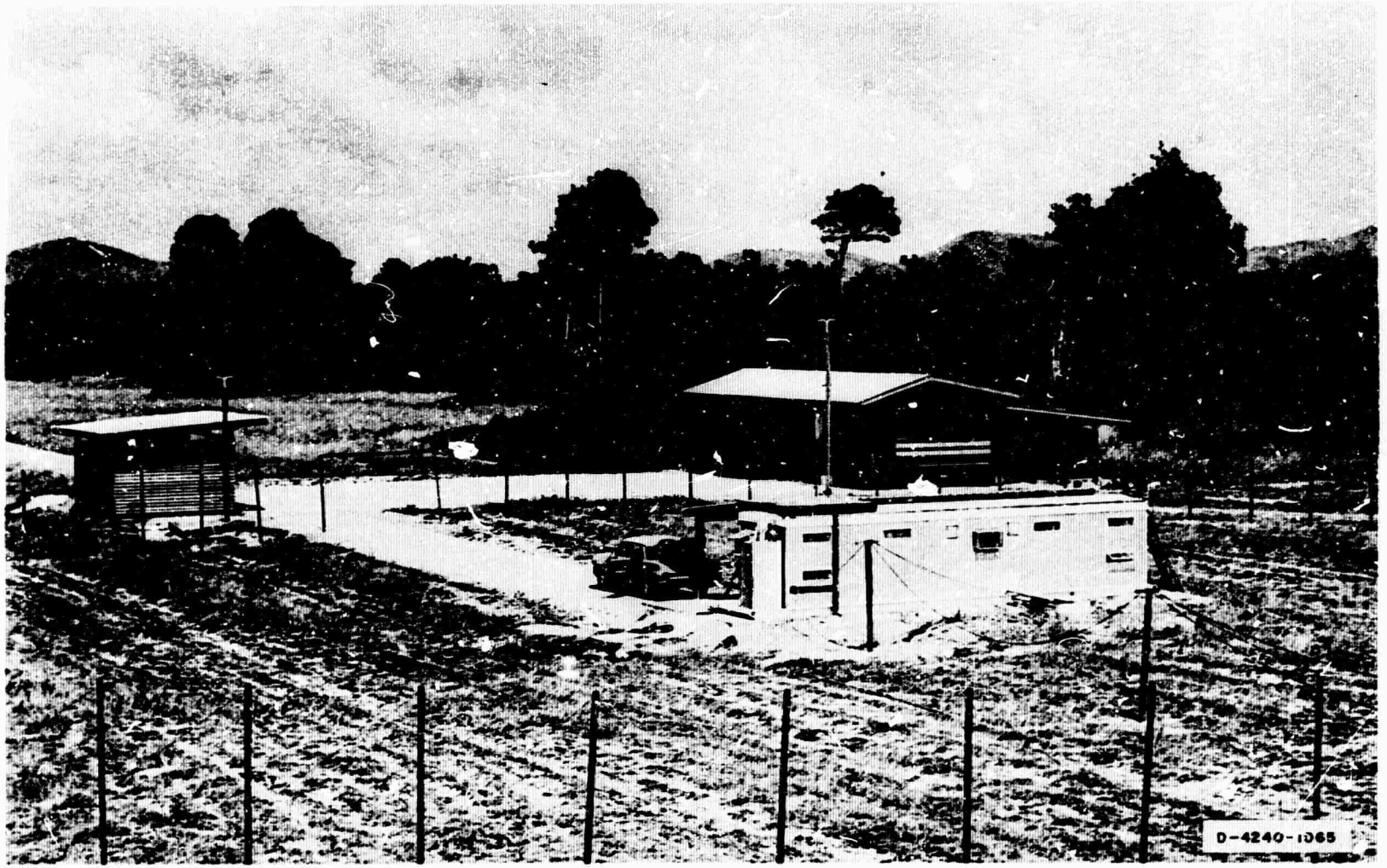


FIG. 3 RADIO NOISE RECORDING STATION

Table I

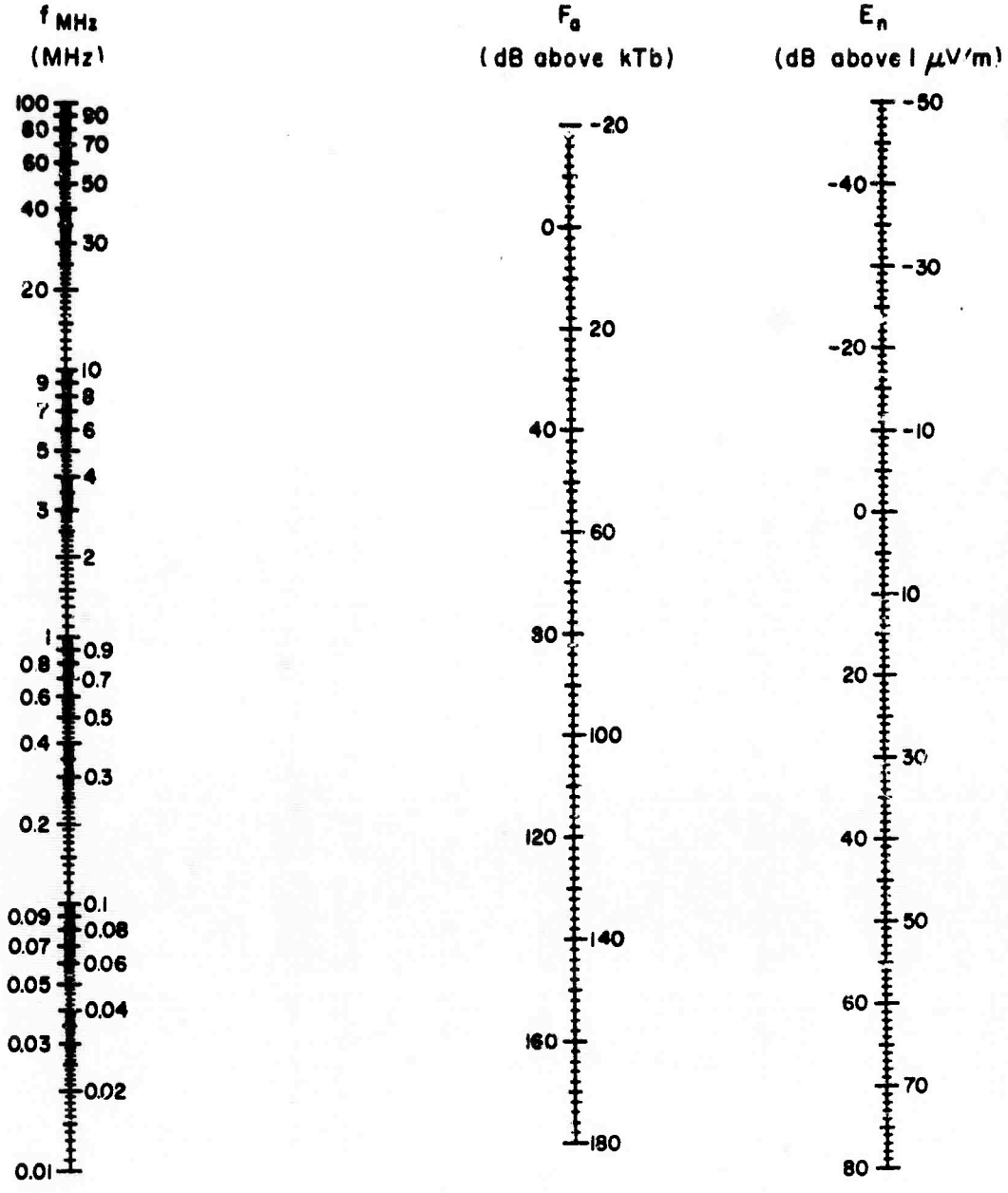
RADIO NOISE MEASURING SITE AT
LAEM CHABANG, THAILAND

GEOGRAPHIC LOCATION		ELEVATION ANGLE OF HORIZON
Latitude	Longitude	
13.05°N	100.90°E	Less than 3 degrees in all directions; zero degrees towards the west (Gulf of Thailand)

Table II

ARN-3 RADIO NOISE RECORDER SPECIFICATIONS

Antenna	Standard 6.6294-meter (21.75 feet) vertical antenna with ground plane consisting of ninety radial wires, each approximately 100 feet long.
Frequencies of Measurement	6, 13, 27, 160, 530, 2,300, 5,000, and 10,000 kHz.
Effective noise bandwidth of receiver	200 Hz
Recording chart speed	5 cm per hour



$$E_n = F_a + 20 \log_{10} f_{MHz} - 65.5$$

DB-4240-261

F_a = Effective Antenna Noise Figure = External Noise Power Available from an Equivalent Short, Lossless, Vertical Antenna in dB Above kTb.

E_n = Equivalent Vertically Polarized Ground Wave rms. Noise Field Strength in dB Above 1 μV/meter for a 1-kHz Bandwidth.

f_{MHz} = Frequency in MHz

Source: ESSA Tech. Report IER 18-ITSA 18-28

FIG. 4 NOMOGRAM FOR TRANSFORMING EFFECTIVE ANTENNA NOISE FIGURE TO NOISE FIELD STRENGTH AS A FUNCTION OF FREQUENCY

II DISCUSSION

The noise data contained in this report are compatible with the data in a series of Technical Notes published by ITSA,* (Series 18) "Quarterly Radio Noise Data." The following two parameters of the atmospheric noise are tabulated in the Appendix:

(1) Mean power

(2) Mean envelope voltage.

The mean power is a basic parameter and is expressed as an effective antenna noise factor, F_a. F_a is defined as the noise power available from an equivalent loss-free antenna in dB above kTb, the thermal noise power available from a passive resistance, where

k = Boltzmann's constant (1.38×10^{-23} joules per degree Kelvin)

b = Effective receiver noise bandwidth (Hz)

T = Reference temperature, taken as 288°Kelvin.

The mean envelope voltage, V_d, is expressed as a deviation in dB below the mean power.

Four frequencies, either in the MF and HF bands or in the VLF and LF bands, may be recorded simultaneously for 30 minutes. Switching between the two sets of four frequencies is accomplished automatically each half hour. The average power and the mean envelope voltage are recorded on an 8-channel strip-chart recorder. The thirty-minute samples are taken as representing the noise condition for the full hour.

The month-hour medians for power and voltage, F_{am} and V_{dm}, respectively, are determined from the hourly values scaled from the chart recordings for each of the corresponding frequencies. Normally, from twenty-five to thirty observations of the mean power are obtained monthly

---

* Institute for Telecommunication Sciences and Aeronomy, of the Institutes for Environmental Research, Environmental Science Services Administration, U.S. Department of Commerce.

for each hour of the day and from ten to fifteen observations of the voltage deviations. When there are fewer than fifteen observations of the mean power or seven observations of the voltage deviations, the tabulated values in the Appendix are identified by an asterisk.

The extent of the variation of the noise power from day to day at a particular hour of the day can be determined from the upper and lower decile values of F_a. These are expressed in dB above and below the month-hour median, F_{am}, and designated by D_u and D_l, respectively, in Table A-1.

Time-block median values of noise are tabulated on a seasonal basis and are obtained by averaging all month-hour medians for the four hours of the day within the three-month period (see Table A-2 and Fig. A-1). The time-block values conform to the seasonal time-block values used in CCIR Report No. 322.*

The results of the noise measurements at MF and HF for the months December 1967, January and February 1968, are given in this report. No data for LF or VLF for these months are available.

* The actual median for a given time block/season should be obtained by rank-ordering the 300 to 360 day-hour values by amplitude and selecting the middle value; however, this involves additional calculation beyond the determination of monthly medians. A reasonable estimate of the true median of F_a and V_d for a given time block and season can be obtained by averaging the monthly medians for that time block and season (average of 12 values), and this approach was used to generate the values in Table A-2 which are plotted in Fig. A-1. It might be noted that this same approach was used in the National Bureau of Standards (NBS) Technical Notes 18-1 through 18-16 by Crichlow, *et al.*, and these data were among those used to generate CCIR Report 322. Beginning with NBS Technical Note 18-17, however, the true seasonal time-block median values were calculated by Crichlow, *et al.*, (the NBS Technical Note 18 series is now called Institute for Environmental Research IER-18 ITSA 18-n, and is published by the Institute for Telecommunication Sciences and Aeronomy, Environmental Science Services Administration, U.S. Department of Commerce, Boulder, Colorado). Mr. Crichlow has pointed out to the authors that, while averaging monthly-median hourly values results in an estimate of F_{am} for a time-block and season that is within a few dB of the true value, the averaging technique can result in substantial errors in D_u and D_l.

APPENDIX

RADIO NOISE VALUES

Table A-1

MONTH-HOUR VALUES OF RADIO NOISE

Station: LAEM-CHABANG, THAILAND Lat. 13.05°N Long. 100.9°E Month Dec. 1967

Hr. (LT)	FREQUENCY (MHz)															
	0.53				2.3				5.0				10.0			
	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}
00	97	10	5	2	70	7	5	4	66	14	8	4	59	15	21	2
01	97	8	6	2	69	6	4	5	66	16	10	4	56	13	19	2
02	96	7	7	2	69	8	5	5	67	15	10	4	56	15	20	2
03	97	7	9	3	68	7	4	5	65	17	9	4	54	14	18	2
04	94	7	7	4	68	5	5	7	66	19	13	4	47	19	11	2
05	94	9	15	4	66	5	4	6	63	21	11	4	46	28	15	2
06	93	5	11	3	67	10	5	5	67	7	6	4	52	19	17	2
07	96	4	11	1	62	8	5	2	59	13	7	4	48	20	13	2
08	88	7	11	1	60	11	11	2	50	9	9	5	43	20	9	3
09	85	13	12	1	53	11	5	2	47	10	9	4	44	12	14	2
10	82	10	8	1	53	10	7	2	43	7	7	5	45	15	16	3
11	78	12	5	1	49	14	3	2	42	7	8	3	47	22	15	2
12	79	13	7	1	49	15	4	2	42	9	8	4	45	22	11	2
13	78	12	7	2	50	12	7	2	43	9	9	4	45	26	7	2
14	79	12	8	1	50	18	5	2	45	10	10	3	45	25	13	2
15	85	8	12	1	53	12	6	1	46	13	8	2	49	20	12	2
16	94	4	10	1	63	11	12	2	55	13	4	2	57	19	21	2
17	95	8	8	1	67	5	9	1	62	9	8	3	48	21	12	2
18	97	7	15	1	73	7	12	2	66	9	6	3	55	17	11	2
19	99	5	14	1	73	7	9	2	70	10	8	4	57	21	10	2
20	98	6	11	2	73	6	5	2	70	9	9	4	56	19	5	2
21	98	6	11	2	71	8	6	3	71	8	10	4	56	25	7	2
22	97	6	10	2	73	9	7	2	71	9	9	3	58	22	8	2
23	96	9	4	2	70	10	5	3	67	11	9	4	59	17	15	2

F_{am} = Median value of effective antenna noise in dB above kTb

D_u = Ratio of upper decile to median in dB

D_l = Ratio of median to lower decile in dB

V_{dm} = Median deviation of average voltage in dB below mean power

Table A-1 (Continued)

MONTH-HOUR VALUES OF RADIO NOISE

Station: LAEM CHABANG, THAILAND Lat. 13.05°N Long. 100.9°E Month Jan. 1968

Hr. (LT)	FREQUENCY (MHz)															
	0.53				2.3				5.0				10.0			
	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}
00	93	7	7	2	69	9	6	4	66	10	9	4	57	18	10	3
01	91	7	3	3	71	6	5	4	64	16	7	4	59	13	11	3
02	91	6	6	3	70	6	5	4	64	10	6	4	54	16	11	3
03	91	4	6	4	67	7	3	6	64	7	9	4	53	10	10	4
04	91	4	6	4	68	5	7	5	66	5	6	4	53	17	13	4
05	89	5	8	4	66	9	7	5	64	5	8	4	53	10	10	4
06	86	8	7	3	67	11	9	4	64	9	6	5	52	16	9	4
07	86	8	7	3	67	14	8	3	59	6	9	4	52	7	7	4
08	84	11	8	3	62	7	8	4	56	11	7	5	48	11	7	4
09	82	6	8	3	55	9	7	3	49	16	9	5	47	8	7	4
10	77	9	6	3	50	10	4	3	42	14	6	4	46	10	7	4
11	76	7	5	2	53	5	9	3	45	10	8	4	47	7	10	4
12	77	8	6	2	54	8	7	3	41	10	6	4	48	8	12	4
13	76	5	5	2	51	6	4	2	43	10	6	4	48	10	12	4
14	76	7	6	2	51	7	5	2	41	12	4	4	48	7	10	4
15	78	10	6	2	54	10	5	3	45	11	7	3	48	7	8	3
16	87	8	7	2	64	8	10	3	53	13	6	3	55	9	13	3
17	93	4	13	2	69	10	11	3	62	8	9	3	53	16	9	3
18	94	6	9	2	74	6	7	3	66	6	6	4	55	18	4	3
19	95	6	5	2	73	6	9	3	65	9	4	4	59	9	7	3
20	94	9	6	2	74	6	7	3	67	10	5	4	59	9	7	3
21	94	6	7	3	75	6	7	3	69	7	6	4	60	7	7	3
22	92	6	8	3	73	5	6	3	69	9	6	4	58	11	5	3
23	92	5	6	3	71	7	5	4	68	6	9	4	58	12	7	3

F_{am} = Median value of effective antenna noise in dB above kTb

D_u = Ratio of upper decile to median in dB

D_l = Ratio of median to lower decile in dB

V_{dm} = Median deviation of average voltage in dB below mean power

Table A-1 (Concluded)

MONTH-HOUR VALUES OF RADIO NOISE

Station: LAEM-CHABANG THAILAND Lat. 13.05°N Long. 100.9°E Month Feb. 1968

Hr. (LT)	FREQUENCY (MHz)															
	0.53				2.3				5.0				10.0			
	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}
00	93	6	5	4	71	5	4	4	73	8	13	4	62	10	10	3
01	93	6	5	4	72	5	10	3	73	8	17	5	59	8	9	2
02	90	5	5	4	73	5	10	3	71	10	4	4	58	5	4	2
03	90	6	5	5	70	8	5	4	74	6	12	3	52	12	7	3
04	88	10	5	5	70	6	8	5	73	7	11	3	53	15	11	4
05	88	9	6	5	70	3	9	6	69	9	13	1	58	12	16	5
06	84	9	6	4	69	11	11	5	67	13	17	5	54	10	11	3
07	82	9	4	5	65	10	8	3	64	9	12	3	47	12	7	2
08	81	7	10	4	64	6	8	3	55	17	5	5	50	4	13	3
09	76	10	8	5	59	10	8	2	52	19	7	6	48	5	13	4
10	72	11	7	4	55	13	10	3	46	12	7	3	42	10	10	4
11	70	10	5	4	54	9	9	3	47	7	9	3	37	10	9	3
12	69	9	6	4	50	12	6	2	47	8	6	3	40	9	9	3
13	68	9	5	5	51	11	10	3	45	13	4	3	41	6	10	3
14	68	15	4	4	52	11	6	4	48	15	7	5	41	7	7	3
15	72	14	9	4	55	8	8	3	53	13	10	5	43	6	7	2
16	79	15	9	3	62	11	9	2	59	10	6	4	47	8	9	3
17	85	8	11	4	69	5	11	2	64	7	10	3	49	8	7	2
18	91	7	8	6	71	15	11	2	68	--	--	1	55	8	6	3
19	93	5	8	5	73	8	7	4	68	11	6	5	55	8	5	3
20	93	5	7	5	72	6	8	3	72	5	8	4	58	11	11	2
21	92	6	8	4	74	6	7	3	74	8	11	4	57	13	9	2
22	95	3	7	4	73	4	4	3	68	10	6	3	56	14	7	2
23	93	5	6	4	71	6	5	4	67	9	7	4	57	10	10	2

F_{am} = Median value of effective antenna noise in dB above kTb

D_u = Ratio of upper decile to median in dB

D_l = Ratio of median to lower decile in dB

V_{dm} = Median deviation of average voltage in dB below mean power

Table A-2

THREE-MONTH TIME-BLOCK VALUES OF RADIO NOISE

Station: LAEM CHABANG, THAILAND Lat. 13.05°N Long. 100.9°E Period Dec. 1967 - Jan.-Feb. 1968

FREQUENCY (MHz)	TIME BLOCKS (LST)																							
	0000-0400				0400-0800				0800-1200				1200-1600				1600-2000				2000-2400			
	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}	F_{am}	D_u	D_l	V_{dm}
0.53	93	7	6	3.2	8º	7	8	3.7	79	9	8	2.7	75	10	7	2.5	92	7	10	2.5	94	6	8	3.0
2.3	70	7	6	4.3	67	8	7	4.7	56	10	7	2.7	52	11	6	2.4	69	8	10	2.4	73	7	6	3.0
5	68	11	9	4.0	65	10	10	4.0	48	12	8	4.3	45	12	7	3.7	63	10	7	3.5	69	8	8	3.8
10	57	12	12	2.6	51	15	12	3.2	45	11	11	3.3	45	13	10	2.9	54	13	9	2.6	58	14	8	2.3

F_{am} = Median value of effective antenna noiae in dB above kTb

D_u = Ratio of upper decile to median in dB

D_l = Ratio of median to lower decile in dB

V_{dm} = Median deviation of average voltage in dB below mean power

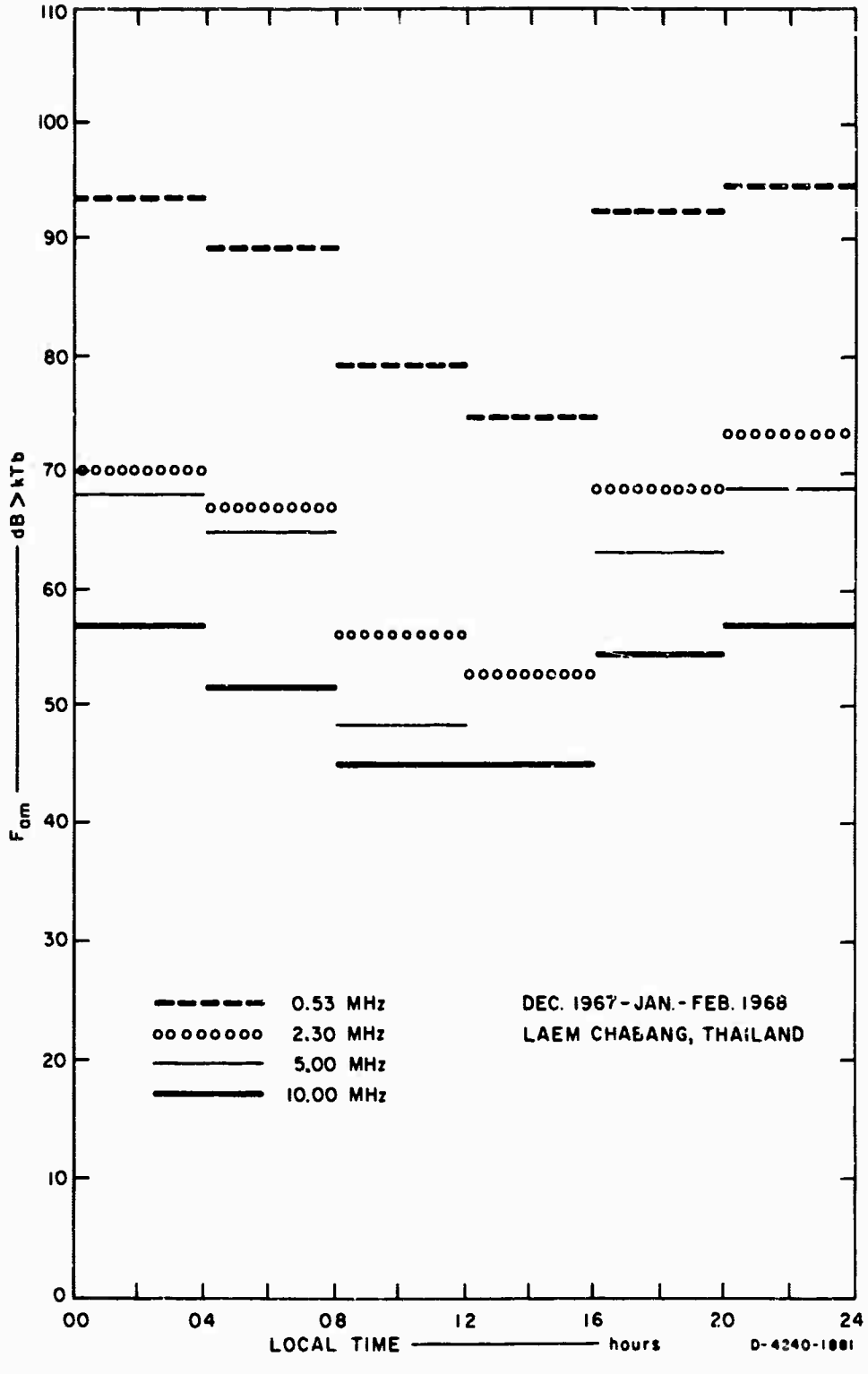


FIG. A-1 THREE-MONTH MEDIAN TIME-BLOCK VALUES OF RADIO NOISE POWER

May 1968

Errata for

Geophysical Data Reports,

"Atmospheric Radio Noise Data, Bangkok, Thailand"

Rangsit Chindahporn, et al.

(March 1966 through February 1968)

The errata indicated below apply to most of the data bulletins in this series.

Page	Line	Reads	Should Read
5	Table I	Latitude	Latitude
		13.55°N	13.05°N
10-13	1	13.55°N	13.05°N
10-12	1	100.9°F	100.9°E
8	13	Report No. 322	Report No. 322.* (See footnote below.)
8	15	No data . . . will be published in subsequent reports.	No LF or VLF data will be published because equipment difficulties caused these results to be questionable.

*The actual median for a given time block and season should be obtained by rank-ordering the 300 to 360 day-hour values by amplitude and selecting the middle value; however, this involves additional calculation beyond the determination of monthly medians. A reasonable estimate of the true median of F_a and V_d for a given time block and season can be obtained by averaging the monthly medians for that time block and season (average of 12 values), and this approach was used to generate the values in Table A-2 which are plotted in Fig. A-1. It might be noted that this same approach

was used in the National Bureau of Standards (NBS) Technical Notes 18-1 through 18-16 by Crichlow, et al., and these data were among those used to generate CCIR Report 322. Beginning with NBS Technical Note 18-17, however, the true seasonal time-block median values were calculated by Crichlow, et al. (the NBS Technical Note 18 series is now called Institute for Environmental Research IER-18 ITSA 18-n, and is published by the Institute for Telecommunication Sciences and Aeronomy, Environmental Science Services Administration, U.S. Department of Commerce, Boulder, Colorado). Mr. Crichlow has pointed out to the authors that, while averaging monthly-median hourly values results in an estimate of F_{am} for a time-block and season that is within a few dB of the true value, the averaging technique can result in substantial errors in D_u and D_l.

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1 ORIGINATING ACTIVITY (Corporate author)

Stanford Research Institute
Menlo Park, California 94025

2a. REPORT SECURITY CLASSIFICATION

UNCLASSIFIED

2b. GROUP

N/A

3 REPORT TITLE

ATMOSPHERIC RADIO NOISE DATA, BANGKOK, THAILAND—December 1967-February 1968

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)

Geophysical Data Report Covering the Period December 1967 through February 1968

5. AUTHOR(S) (First name, middle initial, last name)

Rangsit Chindahporn, Ponsak Buasri

6 REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
May 1968	22	

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
Contract DA-36-039 AMC-00040(E)	Geophysical Data Report
b. PROJECT NO. Order No. 5384-PM-63-91	SRI Project 4240
ARPA Order No. 371	
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	

10. DISTRIBUTION STATEMENT

Distribution of this report is unlimited.

11 SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Advanced Research Projects Agency Washington, D.C.

13 ABSTRACT

None: Data Report

DD FORM 1 NOV 65 1473 (PAGE 1)

S/N 0101-807-6801

UNCLASSIFIED

Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Radio Noise						
Atmospheric Noise						
Radio Noise Recorder						
ARN-3						
VLF, LF, MF, HF						
Thailand						
SEACORE						